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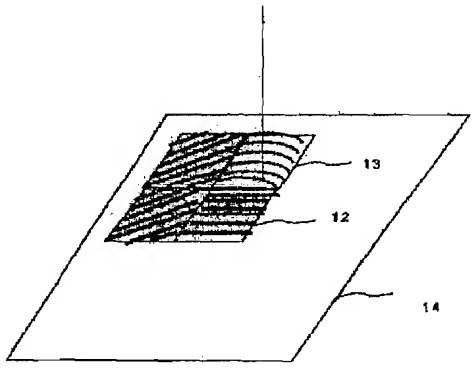
(54) **DIFFRACTION GRATING PATTERN**

(57) Abstract:

PROBLEM TO BE SOLVED: To eliminate irregularity of diffraction efficiency of the whole pattern by letting a two-dimensional pattern constituted of an assemble of micro cells formed of a straight line diffraction grating and a three-dimensional pattern constituted of an assembled of micro cells formed of a curved line diffraction grating co-existing within the same region of the same substrate.

SOLUTION: The diffraction grating pattern is formed by letting a three- dimensional diffraction grating pattern and a planar diffraction grating pattern co-existing within the same region of the same substrate. That is, around a cell 13 made of curved line grating constituting the three-dimensional diffraction grating pattern, a cell 12 made of straight line grating constituting the planar diffraction grating pattern is arranged. Consequently, as each of the three- dimensional pattern and the planar pattern is visually sensed without irregularity of the whole brightness (diffraction effect) and as the perfect pattern, versatile expressions with high eye-catch effect can be realized. Furthermore at the time of used for security use, forgery and imitation become more difficult.



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* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention arranges the minute cell (dot) which consists of diffraction gratings on the surface of a substrate, and relates to the pattern (a diffraction grating pattern is called hereafter) expressed by those meetings.
[0002]
[Description of the Prior Art]The pattern (display) constituted by arranging two or more minute dots which become the surface of a planate substrate from a diffraction grating is publicly known. As a method of producing such a display, the method illustrated by JP,60-156004,A is publicly known. This method changes that pitch, a direction, and light intensity, and exposes the minute interference fringe (diffraction grating) by 2 light-flux interference of a laser beam one after another to a photographic sensitive film.
[0003]On the other hand, not using laser but using electronic beam exposure equipment, by and computer control. The method of producing the display on which the diffraction grating pattern was formed is proposed by moving the X-Y stage in which the planate substrate was laid, and arranging two or more minute dots which consist of diffraction gratings on the surface of a substrate. The described method is indicated by JP,2-72320,A and the U.S. Pat. No. 5,058,992 item. According to the method of using an electron beam, in order to carry out direct writing of the diffraction grating (plaid), the flexibility of the pattern to produce improves by leaps and bounds -- a lattice spacing is changed arbitrarily or it can do with the diffraction grating of not only a straight line but a curve.
[0004]As an example of representation of improvement in the flexibility of a pattern, having enabled it to display a pattern in three dimensions is mentioned. In a three-dimensional display, it is necessary to change the pattern by which vision is carried out according to an observation direction. For example, when the same photographic subject is seen from a different direction (the left / transverse plane / right), vision of the picture of a photographic subject different, respectively will be carried out, and an observer will sense three-dimensional.
[0005]As a proposal concerning the three dimentional display by a diffraction grating pattern, the following is publicly known.
(1) By the dot which consists of a diffraction grating which decomposes each into a dot unit and has a direction according to an observation direction about two or more two-dimensional pictures acquired by observing a JP,3-206401,A photographic subject from the direction of plurality. A two-dimensional picture is drawn as a diffraction grating pattern, and a diffraction grating pattern is formed by the number of sheets of a two-dimensional picture on the same board.
[0006](2) The diffraction grating pattern corresponding to a JP,5-2148,A two-dimensional picture is constituted by the linear diffraction grating, and when the direction of those lattices changes one by one for two or more directions of every to observe, in connection with an observer's view point movement, a display pattern does not necessarily change smoothly. This phenomenon is called "a jump of an image." In order to lose a jump of an image, it is this (2) to change the pitch which constitutes a diffraction grating from a curve (meeting of two or more lines which carried out parallel translation of the same curve in detail), and change and the curve of inclination of a curve move according to a view condition.
[0007]By the way, about the proposal which makes a three-dimensional pattern and a superficial pattern live together in the same field on the same board with the diffraction grating pattern which makes a cell (dot) a constitutional unit, there will be no example of a report by the present.
[0008]A three-dimensional pattern is not what makes a cell (dot) a constitutional unit, It is an existing rainbow

hologram and holographic stereogram, and how to overwrite the superficial diffraction grating pattern which makes a cell (dot) a constitutional unit (multiple exposure) can be considered on the substrate with which they were recorded.
[0009]However, in a described method, the portion which a three-dimensional pattern and a superficial pattern overlap, and the portion not overlapping will be intermingled, and nonuniformity will arise in diffraction efficiency (iuminosity) as a whole, and. In the overlapping portion, since the interference fringe of the three-dimensional pattern equivalent to a ground will be crushed, also when recognizing each pattern as a perfect thing, it becomes evil.
[0010]
[Problem(s) to be Solved by the Invention]This invention does not have nonuniformity in the diffraction efficiency (luminosity) of the whole pattern, and an object of this invention is to provide the pattern which can recognize each of a three-dimensional pattern and a superficial pattern as a perfect thing.
The purpose is to provide the diffraction grating pattern in which the three-dimensional pattern in which each makes a cell (dot) a constitutional unit, and a superficial pattern live together in the same field on the same substrate.
Although the "cell" and the "dot" which are the constitutional units of a pattern are treated as synonymous words, future explanation is unified in the term "cell" which has the nuance which does not receive restrictions in shape (outline) or a size.
[0011]
[Means for Solving the Problem]A minute cell which consists of diffraction gratings a diffraction grating pattern of claim 1 of this invention, In a pattern of how for more than one to be arranged on the surface of a substrate, to be constituted, and for spatial frequency of a diffraction grating, the direction of a diffraction grating, and each cell to be located in a line from which any they are changes at least, A two-dimensional pattern (A) constituted by meeting of a minute cell which consists of a linear diffraction grating, and a three-dimensional pattern (B) constituted by meeting of a minute cell which consists of a curved diffraction grating live together in the same field of the same substrate.
[0012]As for a three-dimensional pattern (B), claim 2 each of a two-dimensional picture with azimuth difference of two or more sheets, It is the diffraction grating pattern according to claim 1 which compounds a two-dimensional pattern of two or more sheets constituted by a meeting of a minute cell which consists of a diffraction grating of a curve according to a direction to display, and is characterized by things.
[0013]Claim 3 is the diffraction grating pattern according to claim 1 or 2, wherein an interval which adjoining cells make is 300 micrometers or less. The above-mentioned interval corresponds to all of intervals of a cell which constitutes a pattern (A), and a cell which constitutes a pattern (B), intervals of the cells which constitute a pattern (A), and interval [of the cells which constitute a pattern (B)].
[0014]
[Embodiment of the Invention]Hereafter, the embodiment of this invention is described using a drawing.
** Three-dimensional production drawing 1 of a pattern (B) is an explanatory view showing the process of obtaining the two-dimensional pattern of two or more sheets used as the foundation which constitutes a three-dimensional pattern (B).
[0015]The plane picture 80 of the object 85 to carry out a three dimentional display is photoed using the television camera 81. That is, the television camera 81 is arranged in two or more positions in which it is specified at intervals of p, and the plane picture 80 of two or more sheets of the object 85 corresponding to each position is photoed. In photography, a photograph may be simultaneously taken by two or more sets of television cameras, and a photograph may be taken, moving one set of a television camera.
[0016]The data of the obtained plane picture 80 of two or more sheets is inputted into the computer 82 using the digitizer 83, and is made to memorize as image data. By the way, the gestalt of these plane pictures 80 may be data and photography data which were recorded on videotape. The object 85 to carry out a three dimentional display may be a virtual body not only by the object which exists but computer graphics.
[0017]Next, in changing the above-mentioned plane picture 80 into a diffraction grating pattern, how to determine direction omega of a diffraction grating and the pitch d of a diffraction grating is explained.
[0018]As shown in drawing 2, it is assumed that an observer observes the pattern 15 which has the diffraction grating cell 16. When wavelength of alpha and the primary diffracted light 92 is set the direction of the primary diffracted light 92 by which reflection diffraction was carried out by theta and a diffraction grating in the degree of incidence angle of the illumination light 91 to lambda, as it is shown in drawing 3, it can ask for direction

omega of the diffraction grating 18, and the pitch d of the diffraction grating 18 (reciprocal of spatial frequency) by the following formulas. The illumination light 91 presupposes that it passes along a Y-Z flat-surface top, and the diffracted light presupposes that it passes along a X-Z flat-surface top.

[0019]

tan(omega) =sin(alpha)/sin (theta)

By using $d=lambda / \{sin^2(alpha)/sin^2(theta)\}^{1/2}$ top type, it becomes possible to ask for direction omega and the pitch d of said diffraction grating 18 for diffracting the illumination light 91 in the arbitrary directions. That is, if the degree theta of incidence angle of the illumination light 91, the direction alpha of the primary diffracted light 92, and the wavelength lambda of the primary diffracted light 92 are given, direction omega and the pitch d of the diffraction grating 18 can be obtained.

[0020]Here, it asks for pitch d' of the diffraction grating [like] diffracted at the front (alpha= 0).

d'= lambda/sin (theta)

Therefore, $d=d'sin(theta)/\{sin^2(alpha)/sin^2(theta)\}^{1/2}=d'cos(omega)$

[0021]As shown in drawing 4, since the upper type is always filled, with the composition which carried out parallel translation of the curve in the fixed pitch, it has composition of the diffraction grating which can observe the wavelength of the always same color at the viewpoint which the diffracted light moves horizontally. In the cell of drawing 4, the curve which constitutes a cell inclines, it is changing from omega1 to omega2, and the curve is located in a line by pitch d'. That is, in order for the range of the horizontal direction of the diffracted light diffracted to obtain the cell of the diffraction grating which is alpha 2 from the angle alpha 1 to the normal of the field where a diffraction grating exists, it is tan(omega1) =sin(alpha 1)/sin (theta).

tan(omega2) =sin(alpha 2)/sin (theta)

D=lambda/sin (theta)

It becomes. Therefore, what is necessary is just to use the diffraction grating which carried out parallel translation by pitch d' for the curve which changes from inclination omega1 to omega2.

[0022]Then, fundamental composition of the diffraction grating cell which constitutes a three-dimensional pattern is considered as composition as shown in drawing 4.

[0023]Next, this cell is divided into three in a lengthwise direction, as shown in drawing 5. And the field divided into these three is set to r1, r2, and r3 from the left. The light which entered into the portion of r1 will be diffracted leftward, the light which entered into the portion of r2 will be diffracted to a front direction, and the light which entered into the portion of r3 will be diffracted rightward. The number of the fields which divide one cell will be divided by the number of sheets of the two-dimensional picture which has not only three but azimuth difference as mentioned above.

[0024]It is good, if a diffraction grating is drawn only about the portion of r1 and nothing draws about the portions of r2 and r3, in shining only from the left and making it like to be able to observe this cell here. In that case, only when an observer has a viewpoint in the range of e1, this cell will shine and he will be seen.

[0025]Suppose that the two-dimensional picture with azimuth difference of three sheets was photoed about a certain three-dimensional object by the procedure explained by drawing 1. For example, if this object is seen from the left, it will be seen from "T" and a transverse plane and it will be seen from "O" and the right, it will presuppose that it is visible like "P." (Such an object does not exist actually)

[0026]Since the number of the two-dimensional pictures with the azimuth difference to be used is three, the cell which constitutes a diffraction grating pattern is divided into three in a lengthwise direction. As shown in drawing 6, when "T" draws the left portion of a cell, "O" draws the center portion of a cell and "P" draws the diffraction grating of the right portion of a cell, a three-dimensional diffraction grating pattern is obtained.

[0027]It reproduces, as the above-mentioned diffraction grating pattern is shown in drawing 7. Leftward "T" can be observed, "O" can be observed in a front direction, and, rightward, "P" can be observed at this time.

[0028]In the above explanation, although the number of the two-dimensional pictures with the inputted azimuth difference was three, the picture included in the eye of an observer's right and left should be differed by using much more parallax pictures. That is, an observer will do vision of the picture which has azimuth difference independently to an eye on either side, and will sense it three-dimensional (three-dimensional) for it. Even when an observer's observation position is moved horizontally, vision of the pair of a picture with the azimuth difference seen from other directions will be carried out, and a natural cubic effect will be acquired.

[0029]Although it is the explanation which produces a three-dimensional diffraction grating pattern, the above is forming a superficial (two-dimensional) diffraction grating pattern in the field to which the diffraction grating

which constitutes "T", "O", and "P" which are the component is not drawn, and serves as a diffraction grating pattern of this invention.
[0030]** production of a two-dimensional pattern (A) -- a superficial (two-dimensional) diffraction grating pattern does not have azimuth difference -- it is a two-dimensional picture of one sheet, and a diffraction grating cell does not need to be constituted by the curved diffraction grating like the cell in the two-dimensional picture which constitutes a three-dimensional diffraction grating pattern.
[0031]geometric as an example of a two-dimensional pattern -- thin -- a crest -- a pattern, a logo, a character, a sign, etc. are mentioned.
[0032]All of the direction and pitch of the diffraction grating which constitutes the above-mentioned pattern, and the shape of a cell do not need to be equal, and they can also give a dynamic visual effect where the diffracted light runs and which is in sight with movement of a viewpoint by the adjoining thing for which the direction of a diffraction grating is changed one by one for every cell.
[0033]Drawing 8 is an explanatory view in which a three-dimensional diffraction grating pattern and a superficial diffraction grating pattern are [about an example of the diffraction grating pattern which lives together in the same field on the same board] local (microscopic). It is the composition that the cell 12 which becomes the circumference of the cell 13 which consists of a lattice of the curve which constitutes a three-dimensional diffraction grating pattern from the lattice of the straight line which constitutes a superficial diffraction grating pattern has been arranged.
[0034]The following considerations are made when setting up the size of a cell and the arrangement space of cells which constitute a diffraction grating pattern.
[0035]The case where it hits that identifying with the naked eye defines the size of the cell which is a difficult grade, for example, the person of eyesight 0.7 separates 70 cm, and vision of the pattern is carried out is considered. Two points as for which the resolution of the eye of the person of 0.7 is 1.4 minute =(1.4/60) **, eyesight left it 70 cm, and more than 300 mum separated are discriminable.
[0036]Therefore, when carrying out vision of the diffraction grating pattern 70 cm apart, about the cell of the size below a 300 mum angle, the existence including shape cannot be recognized by a cell independent. Therefore, since they cannot be independently recognized if the cell which constitutes a pattern (A), and the cell which constitutes a pattern (B) adjoin at intervals of below 300 mum, two kinds of patterns will lap and appear in the portion. Therefore, when giving an impression which a pattern follows an observer and changes to him smoothly, it is effective that below a 300 mum angle carries out the interval and size of a cell.
[0037]The case where a person with sufficient eyesight approaches and vision of the pattern is carried out rather than the above-mentioned case is considered below.
(1) Two points as for which the resolution of the eye of the person of 1.0 is 1.0 minute =(1.0/60) **, eyesight left it 50 cm, and more than 150 mum separated are discriminable.
(2) Two points which the resolution of the eye of the person of 1.5 is 0.66 minute =(0.66/60) **, and eyesight left it 30 cm, and left not less than 58 micrometers are discriminable.
[0038]The above to case (1) It can identify that there is a crevice more than 150 mum between the cells which adjoin each other then, and is a case (2). It can be identified that there is a not less than 58-micrometer crevice between the cells which adjoin each other then. Therefore, vision will be carried out so that a pattern may change smoothly continuously by making into these (150 micrometers, 58 micrometers) followings the interval (crevice) which the cells which adjoin each other within a pattern make, and vision of the cell will be carried out as a bright pattern with which it was covered without the crevice. Although production of a precise pattern is so possible that the interval and size of a cell are made minute, in consideration of manufacturing time and the amount of processed data increasing, the above conditions are appropriate.
[0039]
[Effect of the Invention]When variegated high expression of the eye catch effect is realized since there is no nonuniformity in the whole luminosity about a three-dimensional pattern and a superficial pattern and the vision of each can be carried out as a perfect thing, and it uses for a security use, forgery and imitation become much more difficult.
[0040]Namely, since it is necessary to arrange correctly the cell which constitutes each of a three-dimensional pattern and a superficial pattern from this invention and production of an original pattern is very difficult, The measure against forgery or imitation improves compared with the pattern which a three-dimensional pattern or a superficial pattern twists independently.
[0041]Since there is no nonuniformity of the luminosity (diffraction efficiency) resulting from the existence of a

portion with which both lapped compared with the case where a three-dimensional pattern and a superficial pattern are compounded, by the existing technique, truth judgement becomes easy, and. Without spoiling a design, in order to form all the cells which constitute the both sides of a three-dimensional pattern and a superficial pattern, without overlapping (drawing), in connection with view point movement, a three-dimensional pattern or/and a superficial pattern are recognized, and the peculiar ornament effect is done so.
[0042]

[Translation done.]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]In a pattern of how for two or more minute cells which consist of diffraction gratings to be arranged on the surface of a substrate, and to be constituted, and for spatial frequency of a diffraction grating, the direction of a diffraction grating, and each cell to be located in a line from which any they are changes at least, A diffraction grating pattern, wherein a two-dimensional pattern (A) constituted by meeting of a minute cell which consists of a linear diffraction grating, and a three-dimensional pattern (B) constituted by meeting of a minute cell which consists of a curved diffraction grating live together in the same field of the same substrate.
[Claim 2]The diffraction grating pattern according to claim 1 which a three-dimensional pattern (B) compounds a two-dimensional pattern of two or more sheets which constituted each of a two-dimensional picture with azimuth difference of two or more sheets by a meeting of a minute cell which consists of a diffraction grating of a curve according to a direction to display, and is characterized by things.
[Claim 3]The diffraction grating pattern according to claim 1 or 2, wherein an interval which adjoining cells make is 300 micrometers or less.

[Translation done.]

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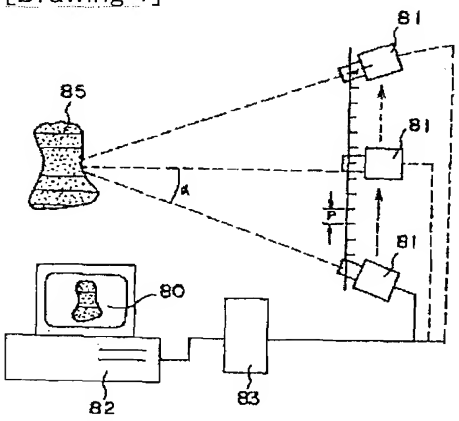
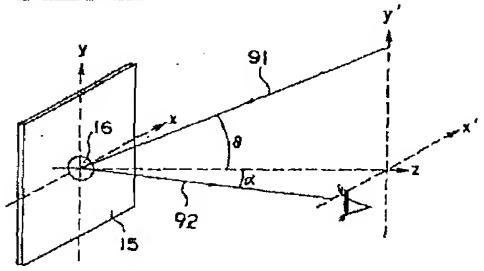
DRAWINGS

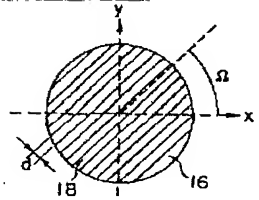
[Drawing 1]



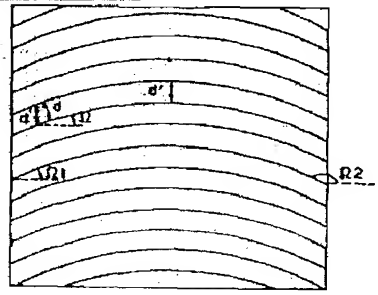
[Drawing 2]



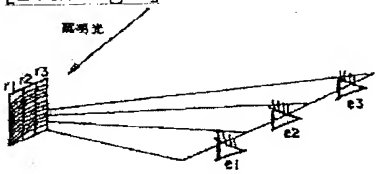
[Drawing 3]



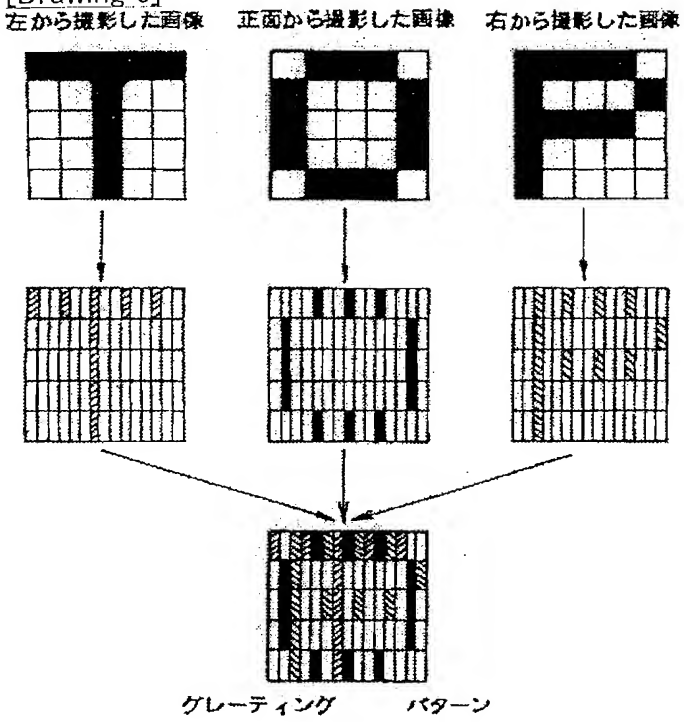
[Drawing 4]



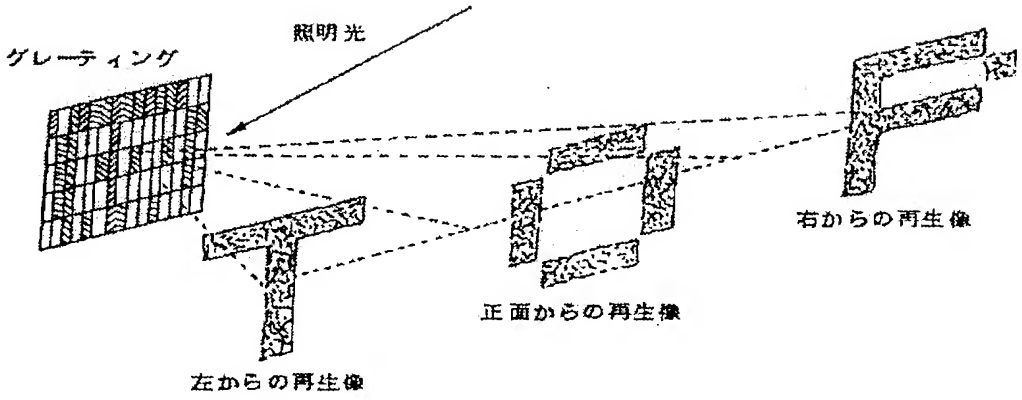
[Drawing 5]



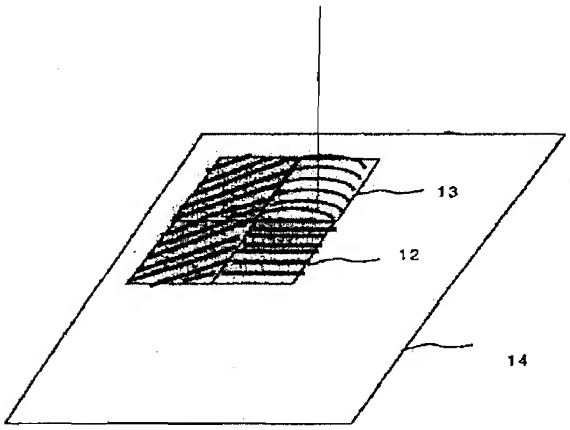
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The explanatory view showing the process of obtaining the two-dimensional pattern of two or more sheets used as the foundation which constitutes a three-dimensional pattern.
[Drawing 2]The explanatory view showing the state of observing the pattern which has a diffraction grating cell.
[Drawing 3]The explanatory view showing direction omega and the pitch d (reciprocal of spatial frequency) of the diffraction grating formed in a cell.
[Drawing 4]The explanatory view showing an example of the cell which consists of a diffraction grating of the curve which constitutes a three-dimensional pattern.
[Drawing 5]The explanatory view showing the relation between the divided field and the emission direction of the diffracted light about the cell which consists of a diffraction grating of the curve which constitutes a three-dimensional pattern.
[Drawing 6]The explanatory view showing the concept which compounds the original picture which forms the diffraction grating used as the pixel which constitutes "T" into the left portion of a cell and constitutes "P" in a center portion at "O" and the right portion, and has azimuth difference on the same board.
[Drawing 7]The explanatory view showing the state of observing the diffraction grating pattern of drawing 6.
[Drawing 8]The explanatory view showing an example of arrangement of a cell about an example of the diffraction grating pattern in which a three-dimensional diffraction grating pattern and a superficial diffraction grating pattern live together in the same field on the same board.
[Description of Notations]
12 -- Cell which consists of a lattice of the curve which constitutes a superficial diffraction grating pattern
13 -- Cell which consists of a lattice of the curve which constitutes a three-dimensional diffraction grating pattern
14, 15 -- Substrate (pattern)
16 -- Diffraction grating cell
18 -- Diffraction grating
91 -- Illumination light
92--primary diffracted light

[Translation done.]